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# Description

# DIGITAL IMAGE CAPTURING APPARATUS CAPABLE OF CAPTURING IMAGES FROM DIFFERENT DIRECTIONS

## BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a digital image capturing apparatus, and more specifically, to a digital image capturing apparatus capable of capturing images from different directions.

[0003] 2. Description of the Prior Art

[0004] As the information industry progresses, information-related products are increasingly used in daily life and conventional analog products are gradually being replaced by digital products. Take the digital camera for example; conventional film cameras utilize chemicals on a film to record images, which can be viewed after development. Moreover, if a user wants to take pictures with special ef-

fects, they are required to be skillful in controlling the stop, the shutter as well as the lens and film development, which is inconvenient for an amateur. In contrast to conventional film cameras, digital cameras convert images into digital signals using a photosensor to directly store them in a memory device. Digital cameras can also be connected to a computer system and store images on its hard disk drive. The images can then be viewed on a screen or printed on a printer. In addition, the user can further process the images recorded by the digital camera using image processing software to produce special effects, which previously could only be realized by a professional photographer with a conventional optical camera, or perhaps even could not be achieved using a conventional optical camera.

[0005] Please refer to Fig.1 showing a front view, and Fig.2 showing a rear view of a conventional digital camera 10. The digital camera 10 includes a lens 12 for capturing light reflected by an object, a shutter button 16 for controlling focusing and shooting, a viewfinder 18, which can be a liquid crystal display (LCD) or a low temperature polysilicon (LTPS) display, for viewing the object, and a control button set 20 for controlling image editing,

browsing and parameter settings.

[0006] Please refer to Fig.3 showing a block diagram of the conventional digital camera 10. The digital camera 10 further includes a photosensor 24 and an image generating module 26. The photosensor 24 can be a charge coupled device (CCD) for sensing light from the lens 12, and the image generating module 26 is for generating an image according to the light sensed by the photosensor 24 so that the viewfinder 18 can display the image.

[0007] When taking a picture of an object, the lens 12 should be turned toward the object, and the user is only able to view the object by the viewfinder 18. If the user wants themselves to be in the picture, they can use a tripod along with a self-timer of the camera, or have someone take the picture for them. However, neither of these methods convenient.

[0008] Please refer to Fig.22 showing another conventional digital camera 150. Components in Fig.22 having the same number as that in Fig.1 function in the same way, thus a further description is hereby omitted. What is different is that a viewfinder 158 is attached to the digital camera 150 by a hinge 152, so that the user can view themselves using the viewfinder 158. However, the hinge 152 not only

has a high cost, but is also highly susceptible to damage.

## SUMMARY OF INVENTION

[0009] It is therefore a primary objective of the present invention to provide a digital image capturing apparatus capable of capturing images from different directions, including taking a picture of the user themselves.

[0010] Briefly summarized, a digital image capturing apparatus includes a housing, a first hole installed on the front side of the housing for inputting light from the front, a second hole installed on the rear side of the housing for inputting light from the rear, a reflector module installed in the housing for reflecting the light input from the first hole or the second hole, a photosensor installed in the housing for sensing the light from the reflector module, and an image generating module installed in the housing for generating an image according to the light sensed by the photosensor.

[0011] The present invention further provides a digital image capturing apparatus including a housing, a lens installed on the housing, being capable of moving back and forth for inputting light from the front or from the rear of the housing, a reflector module installed in the housing for reflecting the light input from the lens, a lens group in-

stalled on a side of the reflector module for focusing the light from the reflector module, a photosensor installed in the housing for sensing the light from the lens group, and an image generating module installed in the housing for generating an image according to the light sensed by the photosensor.

[0012] It is an advantage of the present invention that the user can take a picture of themselves without any help from others.

[0013] It is another advantage that the present invention uses the reflector module to adjust the focus of the light from the first hole or the second hole, so that the lens group can be installed on the right or left side of the digital image capturing apparatus instead of the backside, thus the thickness of the digital image capturing apparatus is reduced.

[0014] It is another advantage that the present invention uses the reflector module to enable self-capturing instead of an inexpensive hinge.

[0015] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various fig-

ures and drawings.

## Brief Description of Drawings

[0016] Fig.1 is a front view of a conventional digital camera.

[0017] Fig.2 is a rear view of a conventional digital camera.

[0018] Fig.3 is a block diagram of the conventional digital camera.

[0019] Fig.4 is a front view of a digital camera according to the present invention.

[0020] Fig.5 is a rear view of a digital camera according to the present invention.

[0021] Fig.6 is a block diagram of a digital camera according to the present invention.

[0022] Fig.7 illustrates the reflector module reflecting light from the first hole according to the first embodiment of the present invention.

[0023] Fig.8 illustrates the reflector module in Fig.7 reflecting light from the second hole according to the first embodiment of the present invention.

[0024] Fig.9 illustrates the reflector module reflecting light from the first hole according to the second embodiment of the present invention.

[0025] Fig.10 illustrates the reflector module in Fig.9 reflecting

light from the second hole according to the second embodiment of the present invention.

[0026] Fig.11 illustrates the reflector module reflecting light from the first hole according to the third embodiment of the present invention.

[0027] Fig.12 illustrates the reflector module in Fig.11 reflecting light from the second hole according to the third embodiment of the present invention.

[0028] Fig.13 illustrates the reflector module reflecting light from the first hole according to the fourth embodiment of the present invention.

[0029] Fig.14 illustrates the reflector module in Fig.13 reflecting light from the second hole according to the fourth embodiment of the present invention.

[0030] Fig.15 is a block diagram of a digital camera according to the second embodiment of the present invention.

[0031] Fig.16 illustrates a digital camera according to the third embodiment of the present invention.

[0032] Fig.17 is a block diagram of the digital camera according to the third embodiment of the present invention.

[0033] Fig.18 is a perspective view of the lens and the reflector module in Fig.16.

[0034] Fig.19 is a perspective view of the lens and the reflector

module positioned on a fourth axis.

[0035] Fig.20 is a perspective view of the lens and the reflector module in Fig.16 according to another embodiment of the present invention.

[0036] Fig.21 is a perspective view of the reflector module in Fig.20 moved along arrow A and the lens moved along arrow B according to another embodiment of the present invention.

[0037] Fig.22 illustrates another conventional digital camera.

## DETAILED DESCRIPTION

[0038] Please refer to Fig.4 showing a front view, and Fig.5 showing a rear view of a digital camera 30 according to the present invention. The digital camera 30 includes a housing 31, a first hole 32, and a shutter button 36. The first hole 32 is installed on the front side of the housing 31 for inputting light from the front of the housing 31. The shutter button 36 is for controlling focusing and shooting. The digital camera 30 further includes a viewfinder 38, a second hole 34, and a control button set 40 for image editing, browsing, and parameter settings. The viewfinder 38 can be an LCD or an LPTS display for viewing an object. The second hole 34 is installed on the

backside of the housing 31 for inputting light from the rear of the housing 31. Both the first hole 32 and the second hole 34 are covered by a transparent material to prevent the entry of dust.

[0039] Please refer to Fig.6 showing a block diagram of the digital camera 30. The digital camera 30 includes a reflector module 48, a lens group 42, a photosensor 44, and an image generating module 46 installed in the housing 31. The reflector module 48 is for reflecting the light from the first hole 32 or the second hole 34. The lens group 42 is for focusing the light from the reflector module 48 on the photosensor 44. The photosensor 44 is for sensing the light from the lens group 42. And the image generating module 46 is for generating an image according to the light sensed by the photosensor 44 so that the viewfinder 38 can display the image.

[0040] The present invention discloses several embodiments of the reflector module 48 as follows. Please refer to Fig.7 showing the reflector module 48 reflecting light from the first hole 32, and Fig.8 showing the reflector module 48a in Fig.7 reflecting light from the second hole 34 according to the first embodiment of the present invention. The reflector module 48a includes a pedestal 50, a first reflector

52, a second reflector 54, and a strobe 56. The pedestal 50 rotates around a first axis 58. The first reflector 52 is installed on a first side of the pedestal 50 for reflecting the light from the first hole 32. The second reflector 54 is installed on a second side of the pedestal 50 for reflecting the light from the second hole 34. The strobe 56 is installed along the front of the pedestal 50 and between the two reflectors 52, 54, and is turned along with the pedestal 50 for providing a light source necessary for the digital camera 30. In the present embodiment, the first axis 58 is perpendicular to the pedestal 50, and the pedestal 50 rotates clockwise or counterclockwise around the first axis 58. The normal lines of the first reflector 52 and the second reflector 54 cross at right angles. When capturing an object visible from the first hole 32, the reflector module 48a is turned as in Fig.7, and the first reflector 52 reflects the light from the first hole 32 to the lens group 42.The photosensor 44 and the image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38. Similarly, when capturing an object visible from the second hole 34, the pedestal 50 carrying the reflector module 48a is turned around the first axis 58 as in Fig.8, and the second reflector 54 re-

flects the light from the second hole 34 to the lens group 42.The photosensor 44 and the image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38.

[0041] Please refer to Fig.9 showing a reflector module 48b reflecting light from the first hole 32, and Fig.10 showing the reflector module 48b in Fig.9 reflecting light from the second hole 34 according to the second embodiment of the present invention. The reflector module 48b includes a pedestal 60, a reflector 62, and a strobe 66. The pedestal 60 rotates around a second axis 68. The reflector 62 is installed on a side of the pedestal 60 for reflecting the light from the first hole 32 or the second hole 34. The strobe 66 is installed along the front of the pedestal 60, and is turned along with the pedestal 60 for providing a light source necessary for the digital camera 30. The acute angle formed between the second axis 68 and the reflector 62 is 45 degrees. In the present embodiment, the pedestal 60 rotates clockwise or counterclockwise around the second axis 68. When capturing an object visible from the first hole 32, the reflector module 48b is turned as in Fig.9, and the reflector 62 reflects the light from the first hole 32 to the lens group 42.The photosensor 44 and the

image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38. Similarly, when capturing an object visible from the second hole 34, the pedestal 60 carrying the reflector module 48b is turned around the second axis 68 as in Fig.10 (in this case the pedestal 60 has actually rotated to a position covering the strobe 66 and the reflector 62), and the reflector 62 reflects the light from the second hole 34 to the lens group 42.The photosensor 44 and the image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38.

[0042] Please refer to Fig.11 showing a reflector module 48c reflecting light from the first hole 32, and Fig.12 showing the reflector module 48c in Fig.11 reflecting light from the second hole 34 according to the third embodiment of the present invention. The reflector module 48c includes a reflector 72, a first strobe 74, and a second strobe 76. The reflector 72 rotates around a third axis 78. The first strobe 74 is for providing a light source necessary for the digital camera 30 when the reflector 72 is turned to a direction for reflecting light from the first hole 32. The second strobe 76 is for providing a light source necessary for the digital camera 30 when the reflector 72 turns to a di-

rection for reflecting light from the second hole 34. The third axis 78 is perpendicular to the normal line of the reflector 72. In the present embodiment, the reflector 72 rotates clockwise or counterclockwise around the third axis 72. When capturing an object visible from the first hole 32, the reflector module 48c is turned as in Fig.11, and the reflector 72 reflects the light from the first hole 32 to the lens group 42.The photosensor 44 and the image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38. Similarly, when capturing an object visible from the second hole 34, the reflector 72 is turned around the third axis 78 as in Fig.12, and the reflector 72 reflects the light from the second hole 34 to the lens group 42.The photosensor 44 and the image generating module 46 in Fig.6 then process the image to display it on the viewfinder 38.

[0043] Please refer to Fig.13 showing a reflector module 48d reflecting light from the first hole 32, and Fig.14 showing the reflector module 48d in Fig.13 reflecting light from the second hole 34 according to the fourth embodiment of the present invention. The reflector module 48d includes a first reflector 82, a second reflector 84, a first strobe 86, and a second strobe 88. The two reflectors 82,

84 are aligned on a line, and the normal lines of the first reflector 82 and the second reflector 84 cross at right angles. The first strobe 86 is for providing a light source necessary for the digital camera 30 when the first reflector 82 turns to a direction for reflecting light from the first hole 32. The second strobe 88 is for providing a light source necessary for the digital camera 30 when the second reflector 84 turns to a direction for reflecting light from the second hole 34. The two reflectors 82, 84 and the two strobes 86, 88 can move up and down toward the lens group 42, in order to receive the light reflected by the first reflector 82 or the second reflector 84, respectively.

[0044] In addition, since the conventional digital camera 10 uses the expanding and contracting of the lens 12 to focus the light on the photosensor 24, the thickness of the digital camera 10 cannot be effectively reduced. Differing from the conventional digital camera 10, the present invention uses the reflector module 48 to reflect the light to the lens group installed on the right or left side of the camera, instead of the backside. Therefore the thickness is reduced.

[0045] Please refer to Fig.15 showing a block diagram of a digital

camera 90 according to the second embodiment of the present invention. The digital camera 90 includes a reflector module 48, a first lens group 92, a second lens group 94, a photosensor 44, an image generating module 46, and a viewfinder 38. Devices in Fig.15 with the same number as that in Fig.6 function the same way and a repeated description is thereby omitted. However, the difference between the two cameras is that, the digital camera 90 has two lens groups 92, 94, wherein the first lens group 92 is installed between the first hole 32 and the reflector module 48 for focusing the light from the first hole 32 on the photosensor 44.The second lens group 94 is installed between the second hole 34 and the reflector module 48 for focusing the light from the second hole 34 on the photosensor 44.The photosensor 44 and the image generating module 46 in Fig.6 then convert the light from the first hole 32 or the second hole 34 into an image to display it on the viewfinder 38.

[0046] Please refer to Fig.16 showing a digital camera 100, and Fig.17 showing a block diagram of the digital camera 100 according to the third embodiment of the present invention. The digital camera 100 includes a housing 101, a lens 102, a photosensor 104, a lens group 105, an image

generating module 106, a reflector module 108, and a viewfinder 110. The lens 102 is installed on the housing 101 and can move back and forth, for inputting light from the front or the rear of the housing 101. The reflector module 108 is for reflecting the light input by the lens 102. The lens group 105 is installed between the reflector module 108 and the photosensor 104 for focusing the light from the reflector module 108 onto the photosensor 104. The photosensor 104 is installed in the housing 101 for sensing the light from the lens group 105. The image generating module 106 is installed in the housing 101 for generating an image according to the light sensed by the photosensor 104. Finally, the viewfinder 110 displays the image generated by the image generating module 106.

[0047] Please refer to Fig.18 showing a perspective view of the lens 102 and the reflector module 108 in Fig.16, and Fig.19 showing a perspective view of the lens 102 and the reflector module 108 rotated around a fourth axis 112. The reflector module 108 includes a pedestal 114, a reflector 116, and a strobe 118. The strobe 118 is installed on the pedestal 114 and can turn along with the pedestal 114, for providing a light source necessary for the digital camera 100. When capturing an object visible from the

front, the lens 102 and the reflector module 108 are turned as in Fig.18, the light from the object passes through the lens 102 and is reflected by the reflector 116 to the lens group, and is then processed by the photosensor 44 and the image generating module 46 to be displayed on the viewfinder 38. Similarly when capturing an object visible from the back, the lens 102 and the reflector module 108 are turned on the fourth axis 112 as in Fig.19.The lens 102 receives light from the object, the reflector 116 reflects the light to the lens group, and the photosensor 44 and the image generating module 46 then process the image to display it on the viewfinder 38. In such a manner, by only turning the lens 102 and the reflector module 108, an object in front or in back can be captured.

[0048] Please refer to Fig.20 showing a perspective view of the lens 102 and the reflector module 108 in Fig.16, and Fig.21 showing a perspective view of the reflector module 108a in Fig.20 moved along arrow A and the lens 102a moved along arrow B according to another embodiment of the present invention. The reflector module 108a includes a first reflector 122, a second reflector 124, a first strobe 126, and a second strobe 128. The two reflectors 122,

124 are aligned, and the normal lines of the first reflector 122 and the second reflector 124 cross at right angles. The first strobe 126 is for providing a light source necessary for the digital camera 100 when the first reflector 122 is turned to a direction for reflecting light from the lens 102a to the lens group. The second strobe 128 is for providing a light source necessary for the digital camera 100 when the second reflector 124 is turned to a direction for reflecting light from the lens 102a to the lens group. When capturing an object visible from the front, the lens 102a and the reflector module 108a are turned as in Fig.20, the light from the object passes through the lens 102a and is reflected by the first reflector 122 to the lens group, and is then processed by the photosensor 44 and the image generating module 46 to be displayed on the viewfinder 38. Similarly, when capturing an object visible from the rear, the lens 102a is moved along arrow B in Fig.20 and the reflector module 108a is moved along arrow A as in Fig.21.The lens 102a receives light from the object, the second reflector 124 reflects the light to the lens group, and the photosensor 44 and the image generating module 46 then process the image to display it on the viewfinder 38. In such a manner, by only turning the

lens 102a and moving the reflector module 108a, an object in front or in back can be captured.

[0049] The digital camera is only an example of the present invention. The present invention can also be applied in other digital image apparatuses such as a digital camcorder.

[0050] In contrast to the prior art, the digital image capturing apparatus according to the present invention uses the reflector module to reflect light from the first hole or the second hole, so that the digital image capturing apparatus can capture an image of an object in front, in back, or even in any other position relative to the digital image capturing apparatus. The present invention does not use an inexpensive hinge. Additionally, the lens group receives the light reflected by the first hole or the second hole, so that the lens can be installed on the right or left side of the digital image capturing apparatus instead of the backside, in order to reduce the thickness of the digital image capturing apparatus.

[0051] Those skilled in the art will readily observe that numerous modifications and alterations of the device may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited

only by the metes and bounds of the appended claims.